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Stability of vitamin D in fish and mushrooms during different cooking procedures

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Introduction

Vitamin D is a group of fat-soluble sterols that come in several forms. The two major forms, which differ in their side chain construction (Fig.1), are cholecalciferol (vitamin D_3) found mainly in foodstuffs of animal origin, and ergocalciferol (vitamin D_2) which is found in certain fungi (mushrooms) and plants. There are very few studies which examine the changes in vitamin D content during cooking processing (1, 2). The information in food composition databases is primarily based on the content of vitamin D in raw food. Dietary intake of processed food needs to be corrected by the retention during the cooking process. Therefore, the purpose of the present study was to determine by HPLC-UV method the content of vitamin D_3 in rainbow trout and the content of vitamin D_2 in mushrooms after different cooking procedures. The retention of vitamin D during cooking procedures usually performed in households i.e. boiling, frying and baking was calculated by formula 1 (3).

Figure 1. Chemical structure of ergocalciferol (vitamin D_2) and cholecalciferol (vitamin D_3) with their natural sources

Material

- Rainbow trout (*Oncorhynchus mykiss*)
- Champignon mushrooms (*Agaricus bisporus*)

The types of heat treatments used in this study are listed for trout in Table 1 and mushrooms in Table 2.

Table 1. Processing performed on trout samples

Rainbow trout (*Oncorhynchus mykiss*)			
Cooking procedure	Abbreviation	Temperature (ºC)	Time (min)
Boiling	C	88 ± 2	8
Boiling, pH 4,0	CL	88 ± 2	8
Steam cooked	S	87 ± 3	6
Microwave cooked	M	High power	2
Pan-fried	P	170 ± 4	8
Baked, oven (uncovered)	BA	110 ± 9	30
Baked, oven (uncovered)	BB	210 ± 12	10
Baked, oven (covered)	BC	190 ± 14	15

Table 2. Processing performed on mushrooms samples

Champignon mushroom (*Agaricus bisporus*)			
Cooking procedure	Abbreviation	Temperature (ºC)	Time (min)
Boiling	C7	88 ± 2	20
Boiling, pH 3,5	C3,5	88 ± 2	20
Pan-fried	PS	Strong fire	5
Pan-fried	PW	Weak fire	20
Baked, oven (uncovered)	O200	200 ± 9	20
Baked, oven (uncovered)	O70	70 ± 6	90

Method

After heat treatment, the samples were homogenized, freeze-dried and saponified over-night. The vitamin D metabolites were extracted from the non-saponified matter followed by solid phase clean-up. Further clean-up was performed with semi-preparative HPLC where fractions of vitamin D_2 and D_3 were collected. The extracts were analyzed by HPLC-UV and quantified using vitamin D_2 and D_3 as internal standards.

Results

$$\%\ True\ retention = \left(\frac{\mu g\ vit\ D\ per\ 100\ gram\ of\ cooked\ food * amount\ of\ cooked\ food}{\mu g\ vit\ D\ per\ 100\ gram\ of\ raw\ food * amount\ of\ raw\ food}\right) * 100 \quad (1)$$

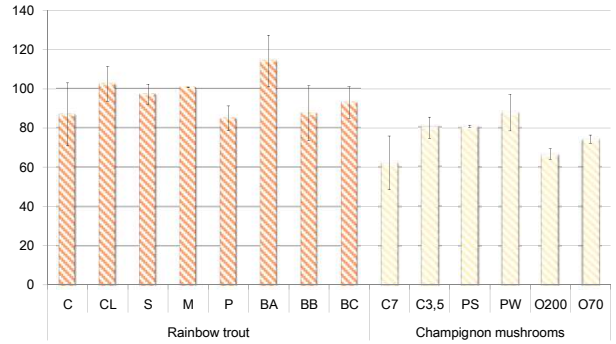

Figure 2. True retention in fish and mushrooms obtained after different cooking procedures

The preparation conditions affected the degree of retention ($p < 0.05$) both in trout and mushrooms samples.

- Trout samples – high true retention (85-114%)
- Champignon samples – lower true retention (62-89%)
  - Longer duration of heating procedure performed in champignon samples
- Acidic pH environment enabled preservation of vitaminD in samples which were cooked in a boiling water

Conclusion

Cooking may cause the significant loss of vitamin D but it depends on the foodstuffs and the kind of heating procedure. Further research has to be done to optimize cooking procedure to enhance retention of vitamin D. Changes in vitamin D retention during heat treatment should be taken into consideration in future calculations of dietary intake of vitamin D.

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